

SILVER COMPOUNDS

CAS Registry Number: 7440-22-4

Ag

Molecular Formula: Ag

Silver is a soft, ductile, lustrous, white metal. It forms numerous compounds such as silver nitrate, silver chloride, and silver sulfide. It is noncombustible except as a powder, and is an excellent conductor of heat and electricity. It is soluble in acids and alkali cyanide solutions, and insoluble in water and alkali. Silver is available in many forms, including sterling (fine) silver (which contains 7.5 percent copper), various alloys, plate, ingots, bullion, moss, sheet, wire, tubing, castings, and powder (HSDB, 1993; Sax, 1987). Silver is not affected by atmospheric oxygen, but is blackened by ozone, hydrogen sulfide, and sulfur. Most silver salts are light sensitive (Merck, 1989).

Examples of Silver Compounds

Silver ammonium compounds	Silver perchlorate
Silver chloride	Silver peroxide
Silver cyanide	Silver sulfide
Silver fluoride	Silver trichloromethanephosphonate
Silver nitrate	Silver trifluoro methyl acetylide

Physical Properties of Silver

Synonyms: Argentum, C.I. 77820; shell silver

Atomic Weight:	107.868
Atomic Number:	47
Valence:	1, 2
Boiling Point:	2,212 °C
Melting Point:	961.93 °C
Density/Specific Gravity:	10.50 at 20 °C
Thermal Conductivity:	1.01 cal/cm/sec/c

(Merck, 1989; Sax, 1989)

SOURCES AND EMISSIONS

A. Sources

Silver is used as an oxidizing agent, in coinage, in photography and silver plating, as a byproduct of operations on copper, zinc, lead or gold ores, in the manufacture of silver nitrate, as silver bromide, for lining vats, for coating mirrors, for electric conductors and equipment, as a sterilant, for water purification, surgical cements, jewelry and cutlery, dental, medical and scientific equipment, light bulbs and batteries (Sax, 1987). The primary stationary sources that have reported emissions of silver and silver compounds in California are gold and silver mining, and crushed and broken stone mining (ARB, 1997b).

Silver (metallic silver) is registered as an algacide for use in swimming pool water systems. It is also used in ceramic water filtering systems to prevent the growth of bacteria. The licensing and regulation of pesticides for sale and use in California are the responsibility of the Department of Pesticide Regulation (DPR). Information presented in this fact sheet regarding the permitted pesticidal uses of metallic silver has been collected from pesticide labels registered for use in California and from DPR's pesticide databases. This information reflects pesticide use and permitted uses in California as of October 15, 1996. For further information regarding the pesticidal uses of this compound, please contact the Pesticide Registration Branch of DPR (DPR, 1996).

B. Emissions

The total emissions of silver and silver compounds from stationary sources in California are estimated to be at least 26,000 pounds per year, based on data reported under the Air Toxics "Hot Spots" Program (AB 2588) (ARB, 1997b).

C. Natural Occurrence

Silver is found native or associated with copper, gold and lead ores, and is associated with argentite, cerargyrite or horn silver, proustite and pyrargyrite. It is found in the earth's crust at 0.1 parts per million (ppm) and in seawater at 0.01 ppm (Merck, 1989). Sediments and minerals can contain from 0.1 to 0.5 milligrams of silver per kilogram (HSDB, 1993).

AMBIENT CONCENTRATIONS

No Air Resources Board data exist for ambient measurements of silver.

Atmospheric concentrations of silver varied little from non-industrial to industrial sites with values ranging from 0.04 to 10.5 nanograms per cubic meter (ng/m³). For example, Chadron, Nebraska, which has a population of 6,000 in a sparsely inhabited region, and San Francisco had the same average ambient air concentration of silver in 0.15 ng/m³ (HSDB, 1993).

INDOOR SOURCES AND CONCENTRATIONS

In a field study conducted in southern California, investigators collected particles (PM₁₀) inside 178 homes and analyzed the particle samples for selected elements, including silver. Two consecutive 12-hour samples were collected inside and immediately outside each home. Silver was present in measurable amounts in less than 10 percent of the samples (Clayton et al., 1993).

ATMOSPHERIC PERSISTENCE

Silver and silver compounds are expected to be particle-associated in the atmosphere, and hence subject to wet and dry deposition. The average half-life and lifetime for particles and particle-associated chemicals in the troposphere is estimated to be about 3.5 to 10 days and 5 to 15 days, respectively (Balkanski et al., 1993; Atkinson, 1995).

AB 2588 RISK ASSESSMENT INFORMATION

Although silver and silver compounds are reported as being emitted in California from stationary sources no health values (cancer or non-cancer) are listed in the California Air Pollution Control Officers Association Air Toxics “Hot Spots” Program Revised 1992 Risk Assessment Guidelines for use in risk assessments (CAPCOA, 1993).

HEALTH EFFECTS

The most probable route of human exposure to silver is inhalation.

Non-Cancer: The simple salts of silver are absorbed from the lung and from the gastrointestinal tract. Silver dust is retained in the lung. Once absorbed, silver is retained in the body. Deposits (as the sulfide) buildup with chronic exposure to visibly stain tissues (argyria). The discoloration may vary from yellow-gray to a black luster, depending on the tissue and the amount of deposited silver (Clayton and Clayton, 1981). Argyria may be spread throughout the viscera or localized to the conjunctiva, nasal sputum and gums. Silver is irritating to the gastrointestinal tract and causes lesions in the kidney and lung (Amdur et al, 1991).

The United States Environmental Protection Agency (U.S. EPA) has not established a Reference Concentration (RfC) for silver. The U.S. EPA has set an oral Reference Dose (RfD) at 5×10^{-3} milligrams per kilogram per day, based on argyria. The U.S. EPA estimates that consumption of this dose or less, over a lifetime, would not likely result in the occurrence of chronic, non-cancer effects (U.S. EPA, 1995a).

Silver is not fetotoxic in rats (Reprotox, 1995).

Cancer: The U.S. EPA has placed silver in Group D: Unclassifiable as to its carcinogenicity (U.S. EPA, 1995a). The International Agency for Research on Cancer has not evaluated silver for its carcinogenicity (IARC, 1987a).